

## ABSTRACT

Large reservoirs of Heavy Oil have been discovered in the Alaskan Arctic, below a thick Permafrost zone. Others are located Offshore, in deep water, off Trinidad, off Brasil, off West Africa, and in other cold environments. The very low temperature of those reservoirs greatly increases the Heavy Oil viscosity. Steam Injection from the surface is the method of choice for economically recovering Heavy Oil, in warmer environments, such as California, Indonesia, Venezuela, Alberta, etc... To be effective, the injection of wet Steam in Arctic wells or in deep Offshore wells, requires that heat losses through the well tubulars carrying Steam or heated Heavy Oil be kept to a minimum.

This is accomplished by a combination of improvements in the general well configuration of Reference (1):

- a) by using two dedicated vertical tubulars, respectively carrying wet Steam, and Heated Oil, through the coldest part of their environment, each at quasi-constant temperatures,
- b) by making each of those dedicated tubulars "super-insulated", so as to reduce their respective heat transfers to the surrounding cold well casing, as much as possible,
- c) by maintaining the temperature of the co-axial casing wall as constant as possible, by means of a Gaseous fluid circulation, at a lower temperature than that of the surrounding well casing,
- d) by reducing to a minimum the temperature gradient across the walls of each of the dedicated tubulars, by placing the heated oil stream in a "super-insulated" annular space, between the "super-insulated" Steam tubular and the co-axial cold casing, kept at a nearly constant low temperature,
- e) by connecting a plurality of multi-lateral "quasi-horizontal" wells to the same two "super-insulated" vertical tubulars, by means of Downhole flow control Modular Systems, including 3-way valves, float valves and gas-lift valves, so that each "quasi-horizontal" well may be sequentially switched, from the surface, from the cyclic Steam Injection mode to that of Oil Production, and vice versa. These Modular Systems are each located below a casing packer, in the lower part of the vertical casing, and also within the curved liner leading to each of the "quasi-horizontal" wells.
- f) by providing easy access to logging or cleaning tools from the surface to any one of the "quasi-horizontal" wells, during the life of the multi-lateral well, and for any work-over operation, if necessary.

The net results are to reduce the Capital and Operating Costs per Oil Barrel, of shared surface facilities and wells, while protecting the environment, and to develop additional large Oil resources, some of them Domestic, which are un-economic by current technology.